

# **Fuel Cells: DOD-Unique Applications**

Ronald Patun (patun@ctc.com; 814-269-2719)  
Heather Moyer (moyer@ctc.com; 814-269-6474)  
Concurrent Technologies Corporation (CTC)  
1450 Scalp Avenue  
Johnstown, PA 15904

## **Abstract**

The National Defense Center for Environmental Excellence (NDCEE), operated by Concurrent Technologies Corporation (CTC), has been tasked to support the Environmental Security Technology Certification Program (ESTCP) in investigating the use of fuel cells in Department of Defense (DOD) applications. This study emphasizes stationary power applications, as apposed to transportation and portable power applications. In addition, this analysis does not preclude any type of fuel cell technology. The applications identified in this task may be met by phosphoric acid, molten carbonate, polymer electrolyte membrane, or solid oxide fuel cell technology.

The information presented is based on the second report in a series of three documents written in support of the ESTCP task.

The first report, issued June 2, 1997, provides a detailed overview of fuel cell technology, fuel cell manufacturers, and key support organizations. In addition, the report summarizes current DOD fuel cell applications and installations.

The second report, which is the focus of this presentation, was issued on June 20, 1997. This report identifies fuel cell applications not currently pursued by the DOD, including premium power, DC power, and hydrogen source applications. To date, most fuel cells installed or to be installed under the fiscal year 1993/1994 DOD fuel cell programs handle non-critical electrical loads, with the primary focus on effective utilization of the recovered thermal energy. However, many other, more critical applications exist that could benefit from fuel cell technology.

The third report is scheduled to be issued in October 1997. This report will provide DOD decision makers with the information necessary to determine if they have a potential fuel cell application, and analyze the economics of installing a fuel cell at their facility. The guidebook will also provide information on siting considerations, environmental issues, and effect of deregulation of the electric power industry on fuel cell implementation.

Fuel cells can provide "premium power" to those critical or semicritical loads that require higher quality and/or reliability than that normally provided by the electric utility grid. Depending on their configuration, fuel cells can provide continuous power while serving as a backup or

uninterrupted power supply. Ten high-impact, premium power applications have been identified for the DOD, as follows

- Medical Treatment Facilities
- High-Security Facilities
- Communications and Data Centers
- Advanced Manufacturing Processes
- Electronics Manufacturing Processes
- Air Traffic Control Facilities
- Radar Sites
- Shipboard Service
- Research and Testing Facilities
- Remote Sites and Field Operations

Similar types of applications exist in the commercial industry and non-DOD government sectors. Examples of premium power applications include the trans-Alaska pipeline, U.S. embassies, and American Indian reservations.

In addition to these premium power applications, several potential DOD applications have been identified for the direct current (DC) power generated by fuel cells. These applications include many electrotechnologies, such as electroplating, electrocoating, and other industrial processes found in many Army, Navy, Air Force, and Marine maintenance and repair facilities.

Finally, potential hydrogen sources that can be used to power a fuel cell have been identified. The DOD can take advantage of this fuel cell applications in facilities that have sewage treatment plants or other means of generating a hydrogen-rich gas, such as heat treatment processes.

Meeting the high standards and critical power requirements of the DOD, fuel cells offer premium power in high-impact applications. In addition, these fuel cell applications meet similar needs found in the government (non-DOD), commercial, and industrial sectors. Successful implementation of fuel cells in these applications will, in turn, facilitate the commercialization and further development of this technology and reduce DOD energy costs, thereby reducing life-cycle costs.

## **National Defense Center for Environmental Excellence**

### **Vision:**

To be a National Resource for the Development, Application, and Dissemination of Advanced Environmental Technologies to the DOD, Other Government Agencies, and Industry.

### **Mission:**

- Assess and Prioritize the Nature and Seriousness of DOD Environmental Problems, and Identify Potential Solutions that Support the DOD Environmental Strategy.
- Transition Environmentally Acceptable Materials and Processes to Defense Industrial Activities and Private Industry.
- Provide Training Which Supports the Use of New Environmentally Acceptable Technologies.
- Perform Applied R&D, Where Appropriate, to Accelerate the Transition of New Technologies.

## **Environmental Security Technology Certification Program (ESTCP) Validation Task**

POP: October 1, 1996 - November 1, 1997

Task 1: Current Uses (June 1997)

Task 2: DOD-Unique Applications (June 1997)

Task 3: DOD Guidebook (October 1997)

## **Objectives**

- Look beyond current Congressionally funded work:
  - Most of the 30 fuel cells, installed or to be installed under the FY 93/94 program, are for non-critical electric and heating applications.
  - Emphasize unique, premium power applications.
- Focus on stationary applications (not transportation or portable power).
- Consider all fuel cell types (PAFC, MCFC, SOFC, PEMFC).

## **DOD Direction**

DOD's goal is to purchase utilities and services, including electricity, from public or private sources, especially for those sites located within the U.S.

The findings from this report will be made available to energy service providers for the purpose of evaluating this opportunity.

## **Methodology**

Literature Search: Web sites, reports, conference proceedings

NDCEE contacts

Survey

## **Expected Benefits of Premium Power**

Reliability (Backup power and UPS capability)

Quality

Security

Cost Avoidance (data loss; product loss; health and safety)

## **High-Impact Premium Power Applications**

Medical Treatment Facilities  
High-Security Facilities  
Communications and Data Centers  
Advanced Manufacturing Processes  
Electronics Manufacturing Processes  
Air Traffic Control Facilities  
Radar Sites  
Shipboard Services  
Research and Testing Facilities  
Remote Sites and Field Operations

### **Medical Treatment Facilities (MTF)**

- Fuel cells could provide premium power for critical and life safety operations, such as surgical services, emergency room, cardiology, intensive care, X-ray, labor and delivery, emergency lighting, and fire detection.
- 130 DOD hospitals and medical centers and 500 clinics worldwide.
- 41 MTFs could benefit from fuel cell technology.
- 163 veterans administration medical centers meet the same criteria for installation of a fuel cell as DOD MTFs.

### **High-Security Facilities**

Examples of secure facilities include: (1) National Simulation Center, F. Leavenworth, KS; (2) Ft. Leavenworth Prison (new facility); (3) National Gold Reserve, Ft. Knox, KY; (4) U.S. Mint, West Point, NY; and (5) Nuclear weapons storage, Elsworth AFB, SD. Devices such as electric magnetic card swipe entryways, and surveillance cameras require reliable power.

### **Communications/Data Centers**

Mission critical data centers support human life critical applications, such as early warning systems, combat information centers, emergency evacuation and support operations, and manned space mission satellite-operations centers.

High-demand data centers support critical applications, such as logistic processing centers, financial processing centers, and telecommunication processing centers.

## **Advanced Manufacturing Processes**

Quality controlled processes having extremely tight tolerances include CNC processing, CAD/CAM, and robotics.

A power outage may result in: (1) increased scrap material, (2) loss of production (throughput), and/or (3) possible equipment damage.

20 DOD sites were identified that have advanced manufacturing processes, including Army depots, Navy aviation depots, air logistics centers, and ship repair yards.

## **Electronics Manufacturing Processes**

Power quality in electronics manufacturing has a significant effect on the quality and cost of DOD electronic devices.

Power problems can cause large financial losses because of lost product and deferred production, for example, semiconductor manufacturing, PCB assembly, and system-level assembly.

## **Air Traffic Control Facilities**

1383 airports worldwide handle military air traffic.

These systems require clean, reliable power for safe operation of communications, computer systems, and runway lights.

## **Radar Sites**

National security is dependent on the reliable operation of worldwide radar sites. NORAD tracks over 8,000 objects in space using information from radar sites and satellites.

Fuel cells could supply primary or backup electrical power at these, often remote, locations.

## **Shipboard Service**

The U.S. Coast Guard and Navy have analyzed the potential use of fuel cells on board smaller combatant ships. Their findings note that fuel cells could:

- Increase survivability by distributing electrical power from multiple sources within the ship.
- Improve fuel efficiency by 12 to 20 percent.
- Lower noise and thermal signatures.
- Reduce environmental impact.
- Match future electrical (DC) power requirements for Naval weapon systems.

## **Remote Sites/Field Operations**

Deployed military units, particularly those that are permanent or stationary, include headquarters units, maintenance units, support units, and field hospitals. DOD facilities are located in Arctic and Antarctic regions. DOD facilities are also located on remote islands.

## **Other (non-DOD) Premium Power Applications**

- **Trans-Alaska Pipeline**, including pumping stations, remote electronic communications stations, and the proposed pipeline expansion.
- **U.S. Embassies:** 253 embassy-related facilities worldwide.
- **American Indian Reservations:** 314 federally recognized reservations; often located in remote areas.

## **DC Power Applications**

Very large amounts of DC power are used in electrochemical processes, such as anodizing, electrocoating, electroplating, electrolytic etching, and electrostatic spray painting.

49 DOD sites require DC power for industrial operations.

## **Hydrogen Source Applications**

Potential hydrogen sources include: industrial processes, such as heat treatment; sewage treatment plants; and other non-DOD sources, such as landfills and agricultural waste.

17 DOD sites have sewage treatment plants that could be used to power a fuel cell.

## **Summary**

Fuel cell technology offers several environmental and operational advantages over conventional fossil fuel power generation methods.

In support of an ESTCP task to investigate the use of fuel cells in DOD applications, CTC has identified several premium power, DC power, and hydrogen source applications for fuel cells.

## **Recommendations**

Based on the positive results presented, additional work is indicated to properly evaluate the DOD applications identified. DOD sites with high-impact applications need to be identified. Information on fuel cell technology needs to be conveyed to the sites. And the potential application and economics of fuel cell technology need to be evaluated, using the DOD Guidebook (to be available October 1997).